GEOLOGY OF THE ISLANDS.

An Interesting Article By Prof. Albert B. Lyons.

WHAT OUR COUNTRY IS MADE OF.

The Formation of the Mountains and Valleys of Oahu—Punchbowl, Diamond Head, Tantalus and Round Top Discussed—Conclusion.

The immediate vicinity of Honolulu offers to the student of historical geology many most interesting problems. The origin of the soil of Honolulu is one of these. Elsewhere in Hawaii nei the soil consists generally, except in the valley bottoms, simply of decomposed lava, fragments of the unaltered rock everywhere encumbering the ground. Here and there only do we find areas of deep soil free from stones. These are mostly in nearly level regions, where frequent rains have favored the rotting of the rock to a considerable depth, while the amount of rainfall has been insufficient to carry off into the ocean the disintegrated rock. In a few cases a deep soil has been formed from decomposed volcanic sand or gravel, which has been spread by an explosive eruption over a large area of land. Honolulu owes its fertile gravelly soil to an occurrence of this kind, so recent that much of the "gravel" remains still undecomposed. It is easy to see that the remarkable group of cinder cones just back of the city are geologically quite new. Loose as is the material composing them, erosion has made little progress as yet in scoring their sides, in spite of such flooding rains as we have had twice within ten months past—upwards of five inches in each storm.

Additional proof of the recency of the eruption or eruptions which heaped them up is found in the presence in portions of the tufa formation at the base of Tantalus of salt in large quantity, although the location is one where the soil is kept constantly damp by frequent rains, and there must be a rapid drain on the salt supply, as the fresh rain water percolates through the tufa. The salt itself, I think it may be assumed, has come from sea water, admitted into the fissure which formed at the time of the eruption, although it seems remarkable that water so admitted should find vent at so great an elevation and at such a distance from the sea. The tufa of Diamond Head is also impregnated in places with salt, one of the spots being near the very top of the cone, and in this instance there would seem to be no question as to how it came there.

There is another incidental evidence which I may mention of connection of the sea with the eruption in Makiki, in the large amount of calcareous matter that has been deposited here, apparently from hot springs. There is near the Makiki fall a bed of rock many feet in thickness, consisting of volcanic gravel cemented together with calcium carbonate. [It is in fact this ledge of hard rock which has made the fall.] Now our volcanic rocks contain so small a proportion of lime that it does not seem likely that water, even at a high temperature, would dissolve out from them sufficient of that mineral to account for any such deposit. The water which came up through the coral formation underlying Diamond Head we know was highly charged with lime, and we may reason that this water also came through a fissure traversing coral rock. It is noticeable that in both instances the carbonate of lime is accompanied also by phosphate, but this is a very common association of minerals.

When these large mounds of volcanic sand were piled up some of the same material was widely scattered, falling over the region to leeward, as far as the harbor on the west, and Punahou street on the south, but mainly in the line of the trade wind, passing Lunalilo Home, the powder magazine and the south shoulder of Punchbowl. [Whether the black sand on the side of Punchbowl and in its crater was from this source or from Punchbowl itself, and so older, is not quite certain. That such material occurred among the ejecta from that crater is beyond doubt, as may be seen by examining the exposed strata in the gap on the east side of the cones. It is hardly probable, however, that any such formations remain now superficial.]

The mouth of Makiki valley must have been closed by the sand heap, the stream thus dammed up after a time cutting through the obstruction, which was in places fifty feet or more in depth, and spreading the sand thus removed over the flat below. Query, was this flat at that time still submerged? I have found no where as yet conclusive evidence of this. I am inclined to believe that the eruptions were coincident with the change of level which made it dry land.

The wash from the hill sides has also carried down much gravel and scattered it in a similar manner, so that the plain is covered to a depth of five to fifteen feet over an extensive area with the debris, from which has been formed a deep rich soil.

Where this debris has been cut into by streams or ditches, there are found frequently in it deposits of calcareous matter, either in crusts as from a hot spring, or in vertical seams, or, most frequently, in forms simulating the roots or branches of trees. While these may have been formed during a period of submergence of the area, it seems more probable that they originated from calcareous hot springs, secondary results of the eruption. Possibly escaping steam may have been the chief agent in their formation, the lime and phosphate which they all contain in rather large proportions being derived from the decomposition of the gravel on the spot. Such deposits must have a bearing on the fertility of the soil, considering how deficient our soils are in general in lime.

In the gravel bed near the Lunalilo Home there is a singular relation of such a calcareous and phosphatic deposit to the gravel, which here evidently lies just where Madame Pele placed it. The lower stratum of the gravel appears whitened in places as though it had imbibed from below water impregnated with mineral. The line of demarcation between the black and the whitened material is sharply defined—not perfectly horizontal, in some places showing in section a straight line, in others the whitened material exhibiting numerous conical (mammillary) projections upward. The sand is not cemented, or is very slightly cemented by the intruding material, which consists of carbonate and phosphate of lime.

Clean black sand, several feet in thickness overlies this formation, compelling one to believe that the lime has been drawn up from beneath, unless it penetrated from above on the side whence the sand has been removed. In the upper strata of the sand deposit there are numerous specimens of what appear like fossil tree trunks and branches. On examination these are found to consist of sand similar to that in which they are embedded cemented together by a whitish, yellowish or rust colored material which proves to be not lime but silica. Sometimes these lie horizontally, confined to a single layer of the sand, and are crowded together as closely as the fleshy roots of the cassava plant. In other instances their position is vertical or nearly so, and they traverse several layers of the gravel. Often they are crooked, not unfrequently branching; in diameter they range from one inch or less to six inches or even a foot or more. Familiar as these objects are in the various gravel pits about Honolulu, I confess that I have not satisfactorily unravelled the mystery of their formation.

In the same gravel pit, there is an interesting bit of history preserved. The gravel had dammed up the stream which drains Punchbowl crater when there is a rain storm. A new channel was cut directly through the gravel of this pit, but this in time became choked with fragments of Punchbowl tufa, washed down from the ridge near the cemetery, and the water found a channel elsewhere. That the tufa is really older than the gravel is shown not far away, where the undisturbed gravel rests on a tufa foundation.

The great explosive eruptions from the Makiki group of vents gave to a large part of Honolulu, as we have seen, a deep fertile soil. Southeast of this area, stretching from Moiliili to Waialae and Diamond Head there is a region which has been flooded, probably at a somewhat earlier date, with liquid lava, which has consequently as yet only a scanty soil, between the bare lava blocks. The source of this lava was the crater of Telegraph Hill.

On the other hand portions of Honolulu owe their soil to disintegration of the tufa of Punchbowl which weathers easily, and yields a fine grained red soil. In some parts of the city, the reef rock has scarcely any covering of soil, while in the extreme western part, the surface consists of the ancient lava formation which seems to have resisted pertinaciously the tooth of time. It has only a scanty soil consisting of disintegrated lava.

In the valley region and about the estuaries of streams there is of course a good deal of alluvial deposit, but even the valley, as far north at least as the cemetery, received its fiery baptism of sand from the Makiki craters.

Microscopical examination of the gravelly soil of Honolulu, shows that it contains in astonishingly large numbers perfectly formed crystals of olivine scarcely at all water worn, but often partly or wholly crusted with oxide of iron. These crystals are commonly studded with minute black octahedra of magnetite, and multitudes of these latter crystals also exist in the soil, their presence revealed whenever a streamlet of water runs down the street after a rain, the crystals being thus segregated as a fine sparkling black magnetic sand.

Even the soils formed by the rotting down of lavas contain generally the same crystals, although often with rounded angles. One may by this means distinguish our volcanic soil from that from almost any continent, which will contain almost inevitably rounded grains of older and more enduring minerals such as quartz.

The region immediately about Honolulu exhibits in epitome nearly all the geologic formations and phenomena peculiar to these islands. Here are the original mountains dissected for us so that we can see how they have been formed by lava sheets spread one upon another, intersected here and there by dykes from beneath. [Of these there is an example, one among many, near the road that goes into Manoa valley, its position marked by a group of bowlder like fragments consisting of the harder compact lava of the dyke, which has resisted weathering better than the surrounding vesicular lava.]

Manoa valley itself seems to have been originally a caldera or great crater formed by collapse or faulting. A typical specimen on a small scale of a volcanic crater with its overflow lava streams, its ejecta of scoriaceous lava, and even of lava bombs lying still where they fell, is found in Telegraph Hill.

Diamond Head is a beautiful specimen of a tufa cone, pure and simple; Punchbowl of a tufa cone which ended in ejection of molten lava, insufficient to form any stream, although several miniature fissures opened in its sides, leaving beautiful examples of eruptive dykes. Tantalus, Sugar-loaf and Round-top, as well as gravel beds, to leeward of them, illustrate the results of explosive eruptions.

The ridges separating Panoa and Nuuanu, Nuuanu and Kalihi, or Manoa and Palolo, illustrate the extreme effects of erosion in dissecting a volcanic mountain, while, in contrast, the ridges between Panoa and Manoa show their angular outlines softened by the covering of volcanic sand that has been sifted over them from Tantalus.

The filling up of the upper parts of Makiki and Panoa has given us also in these valleys picturesque waterfalls and gorges.

Streams diverted from their course by obstructing lava flows are seen in those issuing respectively from Manoa and Palolo, crowded close together by encroaching lava from Rocky Hill on one side and Telegraph Hill on the other. Makiki stream, after having been dammed up by volcanic gravel, has had to form for itself a new channel, giving us thus a pretty illustration of the action of water on comparatively level ground consisting of loose material. The example of the Moanalua stream in cutting through obstructing tufa is most interesting of all.

Effects of hot springs, charged with calcareous matter, are seen on Diamond Head and in connection with other tufa cones, as also in Makiki valley.

The prolonged action of heat from the molten lava of Punchbowl has resulted in giving the tufa of that cone a remarkable semi-crystalline character from crystallization of carbonate of calcium.

Wind drifted sand has accumulated at the base of Diamond Head. The action of the sea has formed also at the base of that cone bluffs, now removed a short distance from shore by elevation of the land. Other evidence of a change of level in the land (or of the sea), is seen in the reef formations which crop out in Honolulu, on Prison island and throughout the Moiliili region.

Of course the coast is fringed everywhere with living reefs, the entrance to Honolulu harbor illustrating the effect on living coral polyps of water from a mountain stream.

Sandstone, formed from shell and coral sand, and conglomerate, or breccia, from tufa fragments or from tufa, lava and coral fragments mixed, are among the interesting formations at the base of Diamond Head, where also may be seen illustrations of the formation of pot holes and parallel groovings, and other exceptional effects of the action of sea waves. The capricious behavior of tidal currents has been recently illustrated to the cost of property owners along the Waikiki beach.

Deposits of oxide of manganese, forming a crust on rocks that have been submerged, are not rare, especially about the base of Telegraph Hill. A crust of the same material covering the surface of some of the tufa on the northeast slope of Diamond Head seems rather to have been deposited from flowing water, although the region may once have been submerged. The lava of the Moiliili quarry, which seems to have flowed over coral, and probably at a recent period, is distinctly amygdaloidal, the result, I think, of submergence.

I have drawn roughly a geological map of Honolulu, recognizing the following superficial formations: 1. The original lava of the dissected mountain mass, in the ridges separating the great valleys. 2. Low land with a soil consisting of ancient decomposed lava (the Palama region). 3. Alluvial deposits from Nuuanu and Kalihi streams. 4. Tufa of Punchbowl. 5. Volcanic sand in situ from the Makiki group of craters. 6. Gravelly soil consisting mainly of decomposed volcanic sand of No. 5, covering much of the plain and extending into Nuuanu Valley. 7. Scoria and lava from Rocky Hill, which seems to extend as far as the Moiliili quarry. 8. Lava from Telegraph Hill. 9. Out-cropping reef rock in Honolulu, Moiliili and makai of Palama. 10. Sand and other coast formations of Kakaako and Waikiki. I have not yet accurately determined the limits of these several areas; the map shows rather work laid out to be done than what has been actually accomplished. I shall try to get help in carrying it out from my next geology class.

The Pacific Cable.

LONDON, Dec. 25.—Mr. Sandford Fleming, the well-known Canadian engineer, says that the Australian colonies and Canada can construct the Pacific cable without an Imperial subsidy. The Times, commenting on the cable question, says it can hardly conceive that the Imperial Government would refuse to grant a subsidy toward the laying of the Pacific cable.

LONDON, Dec. 28.—Mr. Audley Coote, M. L. C., for Tasmania, and representative in Australia of the Societe Francais de Telegraphe Sousmarines, states that a syndicate is ready to lay a fresh cable.

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FROM SAMOA.

A Tourist Gives His Opinion of Our Distant Neighbors.

[From a gentleman who went to Samoa on the Alameda we have received a few lines announcing his arrival, and hope to receive further advices by later mails.]

APIA, Jan. 3.—As at my departure from Honolulu, you said you would like to hear of my arrival and how I liked Samoa, I send you a few lines by the mail that closes today. First impressions are not always correct.

At a distance the Samoan islands look like a series of high hills, but as you come into the bay of Apia you can see that the hills which rise to a height of three or four thousand feet are covered with dense vegetation. The entrance to the harbor of Apia is, as you are probably aware, through a rather narrow channel in the coral reef which girts the island. It must be an impossibility to take a sailing ship out in the face of a strong inland gale. The most conspicuous object noticeable in the harbor is the hull of the German frigate which was wrecked with so many other vessels, in the disastrous hurricane of 1889.

On a steamer's anchoring, it is at once surrounded by a fleet of boats. The native outriggers take off fruits and coral for sale, whilst the othodox four-oared boats convey passengers and visitors to and from the ship. The town of Apia may be said to consist of one street which encircles the bay. There are a good many hotels, the principal being the Tivoli, the charges at which are moderate. I must not be too critical.

The natives seem to be a really amiable lot of people. The men have their bodies tatooed from their waists to their knees. They mostly wear the lavalava, a cloth wound round the waist, and often reaching the ankles. As for the women, many of them have in addition to the lavalava a scarf thrown around the neck and hanging down around in front, thus leaving their back and sides bare.

I thought I had seen cocoanuts in perfection at Hawaii, but the groves here quite throw them into the shade both as to luxuriance and extent of the cultivations. The chief exports are copra and coffee. I have not yet been any distance inland or far around the coast, but hope soon to make an excursion inland with horses and guides. The heat here is certainly very great. There are very few whites, said to number only about 300 to 400, whilst the natives number thirty to forty thousands. The latter are always in a chronic state of confusion. This week there has been a new claimant to the throne put forward.

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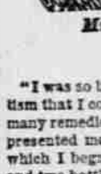

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